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New York, West Shore and Chicago

RAILWAY.

REPORT OF EGBERT L. VIELE,

CIVIL AND CONSULTING ENGINEER.

FEBRUARY 1st, 1872.

NEW YORK:
WEMPLE & KRONHEIM, PRINTERS AND STATIONERS,
62 CEDAR STREET.
1872.

Office of Egbert L. Viele,
Civil and Consulting Engineer,
115 Broadway.

To John M. Courtenay, Esq., *President, and the Board of Directors of the New York, West Shore and Chicago Railway:*

Gentlemen,—In reply to your request of the 15th ult., I have the honor to state that I have carefully examined the data of location and graduation of your railway, which has been submitted to me by General Charles B. Stuart, Engineer-in-Chief, and beg leave herewith to submit the following

REPORT.

The importance of this railway, as a leading element of the railway system of the United States, has been so clearly manifested to me during the course of my examination, that I beg to premise some general views, before referring in detail to the character of the location.

There are now completed within the United States, more than sixty thousand miles of railway, at a cost of $3,000,000,000.

The construction of these railways has been strictly in accordance with the development of population, and

in every instance they have been followed by a corresponding development of physical and industrial resources.

There were more miles of railway constructed in the year 1871 than existed in the whole country twenty years ago. This wonderful and rapid increase of railway structure forms the distinctive feature of progressive civilization in America.

Our railways are the veins and arteries of our national life.

The ratio of the increase of population is the index of increased railway construction. In examining this ratio of increase, we find that the population doubles itself every thirty years. Take for example the five decades preceding the year 1860. The ratio of increase was

From	1810 to 1820	33.13	per ct.
"	1820 to 1830	33.49	"
"	1830 to 1840	32.37	"
"	1840 to 1850	35.87	"
"	1850 to 1860	35.58	"
		5)170.44	
		34.08	

showing an average of 34.08 per cent., or more than $33\frac{1}{3}$ per cent., which is sufficient to double it in thirty years.

It is true that, while the population in 1860 was

31,443,321, in 1870 it was but 38,312,633 ; whereas, in accordance with the foregoing ratio of increase, it should have been 42,162,349. Yet during the last half of that decade, a state of civil war prevailed throughout the entire country, and during a period of five years there was an average of 2,000,000 able-bodied men withdrawn from the pursuits of peace and domestic life ; while, had these men remained undisturbed at their homes, the population would have increased more than the apparent deficit, in accordance with the uniform laws of procreation, so that the exception only proves the rule.

The next important fact is, the locality of this increased population. Statistics tell us that the bulk of the increase is in the West and North-west. A glance at the map of the United States shows us that the railway system has been constructed in accordance with this fact.

We see upon this map a network of thousands of miles of railway penetrating into the West and North-west, and converging as a general rule towards Chicago, the great grain mart of America.

On the other hand we see a series of railways starting from points along the Atlantic seaboard, the centres of finance and commerce, crossing the Middle and Atlantic States, and converging also towards Chicago, reaching out, as it were, their great iron arms

to seize the rich spoils of the Western harvest, and transport them to places of consumption and shipment.

Rival interests springing up have sought to control the bulk of this transportation.

The capital of the Eastern States, centering in the large seaboard cities, has been employed in the construction of lines of railway, which should enhance the commercial status of the several localities from which they originate.

But here an important fact presents itself. The physical geography of the continent exhibits two great mountain ranges running north and south, trisecting the country, and presenting serious obstacles to railway construction. How to surmount these obstacles? Where to find the lowest grades? are the problems which the engineer has been called upon by capital to solve.

It needs no argument to prove that the true axial line of this whole railway system, and the one which shall secure for all time the bulk of the transportation, in spite of every combination that can be formed or conceived, is that one which overcomes these obstacles by the most direct route and on the lowest grades.

The cost of draught on a railway is nearly as the power employed, so that it costs nearly twice as much

to carry a load on a railway with an ascending grade of 24 feet, as to carry it on a level route ; and this element of railway construction increases in importance with the increase of traffic.

Your Engineer-in-Chief, General Stuart, in his very able, clear and concise report, exhibits the comparative statistics of all the railway lines which cross the Alleghany range, and in the location of your railroad, he demonstrates the fact that your line crosses that range on a grade 240 feet below any other line, and that it is the line of lowest grade that can be attained. He also exhibits the fact that it is the shortest line to Chicago.

Here you have the key to the success and future prosperity of your railway, beyond dispute and beyond cavil !

Again, the completion of the Northern Pacific Railway in 1875, will close the last link in the great focal chain, which, concentric with the isothermal line of richest production, is stretched from the Atlantic to the Pacific. Unlike any other line across the continent, the northern line develops the agricultural resources of a belt of territory, nearly every acre of which is arable land.

The equable temperature of this fertile region insures uninterrupted communication throughout the year. All of the vast amount of productions which

this area shall yield for years to come, will seek the Atlantic seaboard by the shortest route and lowest grade.

We now come to the precise line of location of your railway. This line as described in General Stuart's report is as follows :

"For convenience of reference and estimate I have "divided the road into three general divisions, Eastern, "Middle, and Western.

"THE EASTERN DIVISION,

"from Jersey City to Catskill, a distance of 110 "miles, lies immediately on the west shore of the "Hudson, and has an ascent equal to the river tide, of "about four feet, and a maximum gradient not exceed- "ing 10 feet per mile."

"The curves on this division, the shortest on the "whole line, are all within the degree of safety for a "high rate of speed, the minimum being near the "station at West Point, and of 1,200 feet radius. "Unlike the railroad on the opposite side of the river, "there are no reverse curves or tunnels."

"No embankments of any considerable magnitude "will have to be raised. The most difficult work to "accomplish is the rock excavations ; and the most "important of these, from the facility with which the

" excavated material can be disposed of (they being " side cuts), can be speedily and economically done.

" The streams tributary to the Hudson, on the west " side, are few and unimportant, excepting perhaps " the Rondout and Catskill creeks. In bridging these " streams, drawspans will be required, but no formida- " ble obstacles will be met, or extraordinary expendi- " tures necessary.

" Materials for masonry, sustaining and protection " walls, and ballast, are found in abundance, well dis- " tributed along the route, and very easily obtained.

" The stratification of the rock on the western shore " of the river lies at a more favorable angle for re- " moval than on the eastern shore, and, consequently, " the excavations can be made at less cost."

" THE MIDDLE DIVISION,

" from Catskill to Syracuse, is 163 miles in length. " At the former place the line diverges from the river, " or more correctly, the river from this place bears to " the eastward, while the route of the railway con- " tinues in almost a direct line to the Mohawk at " Schenectady. From thence the route lies along the " south side of the valley of the Mohawk, and of the " Erie Canal to Utica ; and from this place it continues " nearly a direct westerly course to Syracuse.

" On this division the steepest grades of the whole

"line will be found. From the Hudson, at or near "Catskill, to the valley of the Mohawk, a distance of "53 miles, the ascent is 220 ft. The ascents, how- "ever, on this portion of the route, can be overcome "by grades that will not exceed 30 feet per mile, "which will be the maximum of the whole line, and in "the direction of the lightest traffic.

"The maximum ascending grade, eastward, in the "direction of the greatest traffic, will not exceed "twenty feet per mile on any portion of the route, "and even this grade occurs but in few places, and "for short distances only.

"From Schenectady to Utica, the ascent of 193 feet "can be accomplished with grades that will not ex- "ceed at any place 30 feet per mile.

"The barrier that lies between the Atlantic coast "and the basin of the Lakes and the Mississippi is "passed at Little Falls, between the two last-named "cities, and at the lowest depression in the Alleghany "range of mountains between the St. Lawrence river "on the north, and the State of Alabama on the south.

"All the railroads south of your line, extending "from the seaboards to the Lakes and Mississippi "valley, pass over this range at various elevations. "The Erie, at 1,800 feet, with a grade of 90 feet per "mile; Pennsylvania, at 2,200 feet, with grades of "125 feet; the Baltimore and Ohio, at 2,000 and

"2,600 feet, with grades for fifteen continuous miles of "116 feet; and the Chesapeake, at 2,000 feet, with "grades correspondingly high."

"The main line of the New York Central Railroad, "between the Hudson and Mohawk rivers, has a sum- "mit of about 450 feet, which is overcome in either "direction by grades of 88 feet per mile."

"From Utica to the western end of this division, the "character of the grades and work is generally light. "Abundance of good materials for the road-bed and "foundations are found, and the facilities for deliver- "ing them at convenient places of distribution by "water carriage are excellent."

"On the south side of the Mohawk, there are found "a less number of streams to be bridged than on the "north side. The most important is the Schoharie "Creek, a stream of no formidable dimensions."

"THE WESTERN DIVISION.

"From Syracuse to the International Bridge at "Buffalo, the distance is 147 miles, and the route a "very favorable one for the construction of your rail- "road. From Syracuse the line continues almost "direct to Buffalo; the Erie Canal and the New York "Central Railroad diverging considerably northward to "Rochester."

"On this division there are found no obstacles

" greater than those usually encountered over a " country of level plains and rolling hills of moderate " elevation.

" Materials for purposes of construction, includ- " ing excellent ballast, are abundant, well distrib- " uted along the line, and easy of access. At " several convenient places, iron, ties and machinery " can be delivered on the line by railroad and canal " conveyance."

With that portion of the line designated as the Eastern division, and which is the most difficult, so far as engineering problems are concerned, I am familiar from personal examination; having, while State Engineer of New Jersey, made a careful survey of all that portion lying within that State, with a view to utilizing its admirable facilities as a navy yard and depot for shipping.

The remarkable geological formation of trap rock is here developed, elevated in columnar masses of cubical blocks, ready for all purposes of construction without the need of quarrying or hammering.

The plain from 1,000 to 1,500 feet in width at its base, terminated by a depth of 30 to 40 feet of water, affords invaluable commercial facilities. The great importance of extensive line of wharf accommodation, is made more clearly manifest from the fact, that although the city of New York is the true terminus of

the trade of the Erie Canal, there never has been provided suitable space for the reception or transshipment of the enormous amount of freight annually conveyed to the city in canal boats.

The completion of the Erie Canal was an era in the history of the country ; for by it there was first opened that commercial pathway to the Great West, along which has moved the silent but resistless tide of immigration, which has spread itself through the Valley of the Mississippi, creating States, erecting cities, and developing the wonderful resources of a vast country which but yesterday was a wilderness in the undisputed possession of savages and wild beasts.

Every five years adds more than a million recruits to that great industrial army, which, while creating homes for themselves, return here the products of their labor, and thus each one pays tribute to the commercial emporium.

This is the source of our prosperity. Every bushel of wheat that is garnered in the West, every rail that is laid upon her roads, every farm that is opened, every house that is built, all pay tribute to the city of New York.

Here are received the products of their industry, and distributed to the world, and in return, from here are sent the necessities and comforts of life, which they do not produce. While each year adds to their

population, and increases their industrial resources, so must each year add to our prosperity.

Yet no adequate provision has been made in all the years gone by for this vast and increasing traffic to be properly transacted. Fleets of canal boats and barges fill the Hudson river, going and coming. Yet when they arrive here there is a struggle for a landing place, and they are scattered along both rivers for ten or fifteen miles, discharging their cargoes where best they can, interfering with the shipping, impeded by ferry boats, incommoded by each other, and all business connected with them is transacted at a great loss of time, labor, and expense.

All this would be obviated by the construction of wharves along the line of deep water fronting the Palisades.

Elevators can be built for storing and re-shipping the grain. Ships of the largest draught can lie at these wharves. The lumber market can have space and facilities for storage and re-shipping not attainable elsewhere. This railway can deliver it directly into the ship if necessary. In short, ample and complete accommodations can be afforded for the vast and increasing traffic constantly pouring into New York.

Beyond this, and as far up as West Point, I have had occasion to make topographical and hydrographical surveys for different purposes, and while a cadet at

the Military Academy, and subsequently in my professional practice, became quite familiar with the remainder of the line of the river. I have also repeatedly passed over the entire line to Buffalo.

I am, therefore, able to verify the report of your Engineer-in-Chief, in reference to the location, which, from his position as State Engineer of New York, and the knowledge then attained, he has been enabled so admirably to determine.

The estimates of cutting and filling, graduation and masonry, prepared by General Stuart, are minute in detail, affording ample means for verification. They are all made with extreme care, and in accordance with established principles. I have no hesitation in affirming that the entire work can be let at the prices upon which the estimates are based.

The final questions which present themselves are, the relations of your road to the one on the east bank of the Hudson river, and the north side of the Mohawk. These are easy of solution.

The west shore of the Hudson possesses a more practicable, more direct and less expensive route for a railway than the east side, for the reasons, that where there are rock formations, the dip is towards the west, leaving in side-cuttings, no overhanging rock to be removed; and where there is earth, the slopes are uniformly more gradual than on the opposite side.

Besides, the currents of all rivers running north and south trend to the westerly side, hence the west shore has fewer re-entrant and salient angles, thus making that side a more direct route. These facts are apparent on the examination of the map, independent of the general propositions which I have stated.

The route from the river to Lake Erie is unquestionably the best that could be selected, and from the fact that the main water shed of the Mohawk is on the north, the location of the line on the south side of that valley saves an enormous amount of bridging, as the streams from the south are few and insignificant in character.

What is now known as the New York Central Road, is a consolidation of a number of short lines of railway undertaken by companies independent of each other, originally projected for the purposes of connecting various towns and districts, and constructed without regard to any general plan. The idea of a through traffic was not conceived by their projectors, and a series of high grades on a patched and reconstructed railway is the result.

Besides, if this railway were in a condition, which it is not, to compete on equal terms with your line, there is a necessity for more than one. It has been stated by the most experienced railway manager in America, that every ten years there is a necessity for a new line

of railway in the direction of every line that leads out of New York. The accumulation of traffic demands it, and experience has verified the assertion.

In closing, I must repeat, that the more I have studied the advantages of your railway, the more I have been impressed by them. Nor can I withhold my tribute to the professional ability and eminent skill displayed in the conduct of the work by your Engineer-in-Chief, General Stuart. The line he has located is unquestionably the most economical, the most direct, and of the lowest attainable grade. His long experience and connection with the most important and successful railway enterprises in this country, have proved of infinite service in determining this unexceptionable line of location, which will, beyond question, for all time be the main artery of railway traffic between the Atlantic and Pacific Oceans.

EGBERT L. VIELÉ,
Consulting Engineer.

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